Citation:

McMillan-Price J, Petocz P, Atkinson F, O'Neill K, Samman S, Steinbeck K, Caterson I, Brand-Miller J. Comparison of four diets of varying glycemic load on weight loss and cardiovascular risk reduction in overweight and obese young adults: A randomized controlled trial.*Arch Intern Med*. 2006 Jul 24; 166(14): 1,466-1,475.

PubMed ID: 16864756

Study Design:

Randomized Controlled Trial

Class:

A - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To compare the effects of low glycemic index (GI) and high protein diets on weight loss and cardiovascular risk.

Inclusion Criteria:

- Young adults, 18 to 40 years of age
- Body mass index (BMI) of 25 or more (calculated as weight in kilograms divided by the square of height in meters)
- Body weight of less than 150kg
- Weight fluctuations of less than 5kg in the previous two months
- Willing to eat red meat and maintain current physical activity.

Exclusion Criteria:

- Chronic illness
- Regular medication other than birth control pills
- Eating disorders
- Special diets
- Pregnancy
- Food allergy
- Insufficient command of the English language.

Description of Study Protocol:

Recruitment

Volunteers were recruited using notice boards and newspaper advertisements.

Design

Randomized controlled trial.

Dietary Intake/Dietary Assessment Methodology

- Dietary compliance and food intake was assessed at zero, four and eight weeks by three-day food diary, including two weekdays and one weekend day
- Food diary information was assessed using a customized database and online resources by a dietitian.

Intervention

Participants were stratified according to weight and sex and randomized to one of four diets for 12 weeks. Participants were given diet plans that were devised to aid weight loss and had similar daily caloric (1,400kcal for women, 1,900kcal for men), dairy, fat (30% total energy intake), type of fat consumed (saturated, unsaturated) and fiber (30g per day) intake. Participants were given instruction regarding appropriate food choices within their plan and instructed to increase foods proportionally if hungry. Participants meet weekly with dietitians and key carbohydrate, protein and some prepared foods were provided.

- *Diet 1:* High carbohydrate (55% total energy intake), high glycemic load (highest of four diets), average protein (15% total energy)
- *Diet 2:* High carbohydrate (55% total energy intake), low glycemic load, average protein (15% total energy)
- *Diet 3:* High protein (25% total energy intake based on lean red meats), high glycemic load based on whole grains, reduced carbohydrate (45% total energy)
- *Diet 4:* High protein (25% total energy intake), low glycemic load (lowest of four diets), reduced carbohydrate (45% total energy.

Statistical Analysis

- Power calculations indicated that 120 subjects (30 in each arm) provided 90% power to detect a 2kg difference in body weight change among groups using significance equals 5%. The primary end points were mean absolute change from baseline in bodyweight and fat mass at week 12
- Pearson x^2 was used to compare the proportion of subjects in each group who achieved 5% or more weight loss
- Univariate and repeated-measures analyses of variance were used to assess the changes in weight, body composition and blood parameters. Changes were assessed with and without adjustment for baseline differences. Missing data were replaced with the last known value for the primary intention-to-treat analysis and excluded in the secondary analysis. SPSS (Version 12.0; SPSS Inc, Chicago, Ill) was used for all statistical analyses.

Data Collection Summary:

Timing of Measurements

- Body weight measured weekly

- Body composition measured at weeks zero and 12
- Blood chemistries measured at weeks zero, six and 12.

Dependent Variables

- *Body weight:* Assessed by electronic scale
- *Body composition:* Assessed by dual energy x-ray absorptiometry (DEXA)
- *Blood chemistries:* Assessed using fasting venous blood. Glucose was measured by glucose hexokinase enzyme assay; insulin and leptin by microparticle enzyme immunometric assay; total cholesterol, HDL-cholesterol and TG by standard automated methods; free fatty acids by a commercially available enzymatic colorimetric test kit; C-reactive by near-infrared immunonephelometry. Hyperinsulinemia was defined as fasting insulin levels higher than 16µIU per ml (110pmol per L) and hypertriglyceridemia as fasting TG levels greater than or equal to 133mg per dL (1.5mmol per L)
- *Beta-cell function and insulin sensitivity:* Assessed from glucose and insulin concentrations using HOMA1 [(fasting glucose - fasting insulin)/22.5] and HOMA2 (described by Wallace et al) models.

Independent Variables

Assigned diet plan.

Control Variables

Analysis was adjusted for baseline characteristics of study participants (weight, BMI, gender, clinical chemistries, etc.).

Description of Actual Data Sample:

- *Initial N:* 129 enrolled in the study (31 males, 98 females)
- *Attrition (final N):* 116
- *Age:* 18 to 40 years
- *Anthropometrics:* Diet groups were statistically similar for all baseline measures compared
- *Location:* Outpatient intervention, Australia.

Summary of Results:

Significant Differences Between Diet Groups Among All Study Participants

Variables	Diet 1 (N=32)	Diet 2 (N=32)	Diet 3 (N=32)	Diet 4 (N=32)	Statistical Significance of Group Difference
Weight change, percentage (kg; Mean ± SE)	−4.2%±0.6%	−5.5%±0.5%	−6.2%±0.4%	−4.8%±0.7%	P=0.09

Subjects with more than 5% loss, percentage	31	56	66	33	0.01

Significant Differences Between Diet Groups Among Women

Variables	Diet 1 (N=25)	Diet 2 (N=23)	Diet 3 (N=24)	Diet 4 (N=26)	Statistical Significance of Group Difference
Change in weight	-3.1±0.5	-4.8±0.5	-5.4±0.5	§ −3.5 ± 0.5	P=0.006
Weight change, percentage	-3.7±0.6	-5.7±0.6	-6.5±0.5	-4.1±0.7	P=0.004
Subjects with more than 5%	25	61	75	23	P<0.001
Change in waist, cm	-3.2±0.7	-5.8±0.8	-6.2±0.8	-39±0.7	P=0.02
Change in fat mass, kg	-2.5±0.5	-4.5±0.5	-4.6±0.5	-2.9±0.5	P=0.007

Other Findings

- There was a significant interaction between gender and diet (P=0.008)
- There were no significant (NS) differences between groups for differences in lean body mass
- LDL-C levels decreased in diet group two and increased in diet group three.[−6.6±3.9mg per dL (−0.17±0.10mmol per L)], but increased in the diet group three [10.0±3.9mg per dL (0.26±0.10mmol per L); P=0.02].
- There was no effect of diet on HDL-C, TG, free fatty acids and C-reactive protein; total:HDL-cholesterol ratio; or glucose homeostasis
- Both total and HDL increased in diet group three (+5% and +8%, respectively) and decreased with diet group two (−4% and −6%, respectively; P=0.03 and P=0.01 for pair-wise comparisons)
- Overall, the GI, but not the protein content, had a significant effect on change in TC levels (P=0.02) and LDL-C levels (P=0.009)
- Diet had significant effects on changes in leptin levels (P<0.006), which decreased more in the diet group two, with a significant interaction between GI and CHO content (P=0.003)
- Absolute decrease in leptin levels correlated with change in fat mass (R=0.27; P=0.003), with no additional effect of GI or CHO content
- Changes in fat mass were correlated with changes in fasting insulin concentration (R=0.19; P=0.03) and changes in insulin sensitivity as measured by HOMA2 (R=0.20; P=0.02)
- Participants from all groups achieved intended carbohydrate and protein distributions. There was no difference in reported energy intake and all groups reduced fat intake. Diet groups one and two ate less fat than diet groups three and four (P<0.001), although the ratio of saturated tounsaturated fatty acids remained constant. The high-protein groups consumed

more cholesterol than the high-CHO groups [293±18 (mean±SE) mg per day, 239±18mg per day, 125±10mg per day and 119±14mg per day on diets one, two, three and four, respectively; P<0.001].

Author Conclusion:

Both high-protein and low-GI regimens increase body fat loss, but cardiovascular risk reduction is optimized by a high-carbohydrate, low-GI diet.

Reviewer Comments:

Authors on the paper have disclosed that they have previously written books that focus on glycemic index in diet, weight loss.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes

2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	???
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A

5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	???
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	???
7.7.	Were the measurements conducted consistently across groups?	Yes

8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
	8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
	8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	Yes
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	Yes
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		Yes
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		???
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	???